Human Factors in Entertainment Computing: Designing for Diversity

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ABSTRACT
Although several casual gaming systems have been developed during the past years, little research examining the impact of human factors on the design and use of digital games has been carried out, and commercially available games are only partially suitable for audiences with special needs. The research project described within this paper aims to analyze and explore design guidelines for diverse audiences and results of focus group gaming sessions to develop a research toolbox allowing for the easy creation of adaptable and accessible game scenarios. Thereby, a controllable environment for the detailed evaluation of the interrelations between human factors and entertainment systems is provided. Results obtained by further testing will be integrated in the toolbox, and may foster the development of accessible games, thus opening up new opportunities for diverse audiences and allowing them to further engage in digital games.

Categories and Subject Descriptors
H.5.m [Information Interfaces and Presentation (e.g., HCI)]: Miscellaneous; K.4.2 [Computers and Society]: Social Issues – *Assistive technologies for people with disabilities, Handicapped persons/special needs*; K.8.0 [Personal Computing]: General - *Games*.

General Terms
Design, Experimentation, Human Factors, Theory.

Keywords
Accessibility, Authoring, Games for Children, Serious Games, Silver Gaming, Usability, User Experience.

1. INTRODUCTION
Digital games no longer represent a niche activity and have become an integral part of daily life for large parts of society [13]. Also, industry efforts have increasingly been directed towards the inclusion of wider audiences, for instance girls and adult gamers, through the development of more casual gaming environments such as the Nintendo DS and Wii consoles, which facilitate the participation of occasional gamers by providing an easy entry into play and simple game mechanics. Also, research results suggest positive effects of playing games on the emotional and physical well-being of special audiences [10], hence games may be used to positively influence people's lives.

However, little research is available on the suitability of entertainment products for diverse audiences with special needs including young children [4], senior citizens [5] and disabled or ill persons [11], and their needs and requirements are only partially addressed by commercially available games and entertainment systems, therefore excluding them from participating in play.

Within my research project, I aim to address this issue by providing a toolbox designed for the quick creation of game scenarios based on existing considerations regarding the design of accessible digital games, which is designed to further explore the creation of digital games for diverse audiences. Furthermore, I will apply exemplary games as research tools in focus group tests and evaluations to verify theoretical assumptions and to compile additional design recommendations for target audiences with special needs.

2. RELATED WORK
Work related to the topic of my thesis addressing human factors in entertainment computing is manifold, ranging from considerations regarding the usability and accessibility of digital entertainment systems to player experience research and the design of case studies, authoring environments and research tools. Also, human factors research in other areas may have implications on the design of accessible, yet entertaining games.

Usability research in games has evolved during the last years, considerations specifically addressing issues related to the assessment of interactive products as well as an overview of existing methodological approaches is provided by Isbister and Schaffer [9]. Additionally, playability research and the exploration of user experience in games try to provide insights into the players' interactions with digital games beyond interface issues and try to account for the effects of game elements and mechanics on the user's individual, affective gaming experience [2], [14]. Also, the issue of accessibility is increasingly addressed by digital games research [2]. Different design recommendations regarding the design for diverse audiences are available, for

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instance Adams' considerations addressing gender-inclusive game design, games for children as well as accessibility in games [1].

Apart from these aspects with regard to contents, my work is related to the design of authoring environments and logging frameworks such as the logging framework for gaze-based interaction [12]. Based on these foundations, it is planned to develop a research toolbox which is described in the following section.

3. PROPOSED RESEARCH

This section gives an overview of my research proposal which is based on prior work including the design of games for children and senior citizens. Furthermore, it provides an outline of the most important research goals, my research plan and an overview of preliminary results.

3.1 Prior Work

Previous work in the area of serious game design was carried out by the Entertainment Computing Group at the University of Duisburg-Essen, Germany and focused on the design and evaluation of case studies directed towards various target audiences which include implications for my future research.

The *Serious Game for Dental Health* [6], [7] addresses children and teenagers developing their second dentition and tries to motivate players to improve dental hygiene. Through the implementation of a tangible interface consisting of a tooth brush, a cup of mouthwash and dental floss, the system tries to foster the transfer of in-game knowledge to everyday life. An initial focus group evaluation has shown that children generally enjoyed using the system and highlighted that they liked the concept, but observations suggested a slightly higher entry barrier for players using tangibles than for those testing a mouse and keyboard version of the game.

SilverBalance is an interactive research tool designed to examine the use of the Nintendo Wii Balance Board and similar devices among senior citizens [8]. It offers basic interaction paradigms which require the player to shift weight left, right or forward according to in-game events and grants easy access to game metrics such as player scores, elapsed time as well as the player's attempts at using the board. Also, a simplistic graphical design and easily accessible game mechanics were developed to address the needs of both active and frail elderly players. First evaluation results suggest that balance boards may be used as input devices even if players are frail, but additional considerations are necessary to create suitable games.

3.2 PhD Project

Within my thesis, the overall goal is to examine the impact of human factors on the design and use of digital entertainment systems, particularly digital games. Attention is particularly focused on audiences with special needs, such as children, senior citizens and persons facing chronic diseases or disability within a serious gaming context as research suggests a possibly positive effect of playing digital games on these groups.

Therefore, planned work includes the theoretical analysis of existing approaches towards game usability and accessibility in order to derive implications for the design of digital games on a technical level. In this context, special attention is paid to the demands of diverse target audiences and how technology can be utilized to address their needs. Furthermore, one part of research will be the conduction of focus group evaluations using commercially available games with different audiences such as children or elderly to gain further insight into the use of input devices and digital games, and how human game interaction is influenced by different cognitive and physical predispositions. It is expected that the requirements of the main audiences overlap to a certain degree, for instance regarding the complexity of interaction paradigms, therefore facilitating the development of common interaction paradigms. Based on these considerations, recommendations regarding the design of entertainment interfaces and game mechanics for diverse audiences will be deduced.

To validate the theoretical foundation, it is then planned to construct a framework which allows for the closer and more focused examination of needs and abilities of specific user groups. This research toolbox (cf. figure 1) will integrate existing design recommendations into a small-scale modular authoring environment designed to facilitate game and interface design processes while allowing for an easy setup of in-game evaluations.

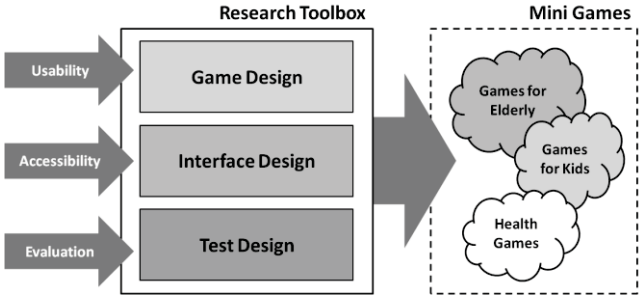

Figure 1. The research toolbox will be designed based on theoretical analyses and focus group research to facilitate the creation of mini games for diverse audiences.

The goal of the toolbox is to provide a controllable environment for the examination of user requirements through the creation of mini-game scenarios addressing different target audiences, such as games for kids, games for health or games for elderly players (cf. Figure 1). Furthermore, it is planned to provide basic routines which facilitate the implementation of alternative interaction paradigms, e.g. featuring haptic controllers such as the Nintendo Wii Remote and Balance Board, full-body input devices such as Microsoft Kinect, as well as keyboard and mouse input. Additionally, the toolbox will provide users with the possibility of easily integrating evaluation material such as questionnaires into their mini games while also tracking game metrics such as elapsed game time, player scores and other indications of the feasibility of certain game elements. Therefore, it is necessary to offer a basic backend which allows for the creation of mini games by experts with programming skills based on predefined game templates as well as exemplary game mechanics which are suitable for broad audiences. Additionally, it is planned to include an extended options menu in all games allowing for basic adjustments of game play such as visuals, game speed and pacing, adding and removing game elements and an easy exchange of input devices and interaction paradigms to adjust scenarios to the needs of different audiences.

Thereby, resulting game scenarios may be used to explore the use of digital games among particular audiences and examine

differences as well as similarities between groups on three levels. First, further research regarding the usability and accessibility of certain interaction paradigms may be carried out. Second, playability issues related to the feasibility of game mechanics and the overall complexity of digital games can be explored. Finally, mini game scenarios may be used to evaluate user experience beyond "core gamer" audiences and to further explore affective gaming experiences of special audiences. Thereby, the development of accessible games may be fostered, opening up new opportunities for diverse audiences and allowing them to further engage in digital games.

Also, empirical results obtained through these evaluations can be used to reconsider original design considerations, to update the toolbox suggested within this paper and to compile comprehensive design recommendations which may ultimately foster the consideration of diverse audiences in commercial game development.

3.3 Preliminary Results

During the work on my Master's Thesis, I explored the potential of digital games for frail elderly players. Based on theoretical considerations and focus group gaming sessions, design recommendations were derived and integrated into the game concept *SilverPromenade*. Insights into the needs and requirements of senior gamers which were obtained during this period may also be applied to the design of the research toolbox and mini game scenarios presented within this paper.

Additionally, the Entertainment Computing Group at the University of Duisburg-Essen has explored the creation of authoring environments for expert users, and resulting software modules might be implemented into my research toolbox.

4. CONCLUSION

In this paper, my approach towards the design of accessible games for diverse audiences was described. Through the creation of a research tool allowing for the assessment of player performance and user experience, the integration of both technical and user-centered perspectives on human factors in entertainment computing shall be examined to facilitate the design for accessibility and including broader audiences in digital gaming.

Besides a further analysis of theoretical considerations regarding game design for special audiences, future work includes the definition of game scenarios which are particularly flexible and may be integrated into the research tool as game templates. Therefore, it is necessary to explore the suitability of different game genres and bring in focus groups to investigate their feasibility for different player groups.

Generally speaking, I hope to foster the collaboration of psychology and computer science through my work and contribute to open issues in game design for diverse audiences. Additionally, some of the insights gained through this work might be transferred to other areas of life in which human factors play a crucial role. Finally, I hope that the design of accessible technology might contribute to the quality of life of persons with special needs.

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